

**LINCOLN COUNTY – LINCOLN COUNTY LANDFILL  
ASSESSMENT WORK PLAN  
C&D PHASE I LANDFILL  
CROUSE, NORTH CAROLINA**  
S&ME Project No. 1356-13-009

Prepared for:  
North Carolina Department of Environment and Natural Resources  
Division of Waste Management – Solid Waste Section  
1646 Mail Service Center  
Raleigh, North Carolina 27699-1646

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November 05, 2013



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North Carolina Department of Environment and Natural Resources  
Division of Waste Management – Solid Waste Section  
1646 Mail Service Center  
Raleigh, NC 27699-1646

Attention: Ms. Jaclynne Drummond  
Compliance Hydrogeologist

**Reference: Assessment Work Plan - C&D Phase I Landfill**  
Lincoln County Landfill  
Crouse, North Carolina  
S&ME Project No. 1356-13-009

Dear Ms. Drummond:

The enclosed is an Assessment Work Plan for the Lincoln County C&D Phase I Landfill. This plan is in response to your email dated August 20, 2013 to Lincoln County requesting an assessment monitoring work plan due to the volatile organic compound tetrachloroethene (PCE) exceeding North Carolina 2L Standards in compliance monitoring well MW-28. Due to MW-28's close proximity to the unlined MSW portion of the landfill "Area E", it is suspected that the PCE exceedances are coming from Area E and not the C&D Phase I landfill. Therefore, on behalf of Lincoln County, S&ME has prepared this Assessment Work Plan focused on an alternate source demonstration (ASD) intended to establish Area E as the source of PCE exceedances in monitoring well MW-28.

Respectfully submitted,

**S&ME, Inc.**

*Courtney W. Murphy*

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cc: Mark Bivins, Lincoln County Solid Waste Manager

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## 1. PROJECT INFORMATION

Groundwater monitoring well MW-28 monitors groundwater up-gradient of the C&D Landfill and is positioned in a buffer area between the unlined MSW landfill “Area E” to the west and Phase I of the C&D Landfill to the east (here forward referred to as “buffer area”). The location of Area E, the C&D Landfill, and groundwater monitoring well MW-28 are shown on the attached **Drawing 1 of 1**. Phase I of the C&D Landfill was closed with an intermediate cover and remains hydraulically connected to Phase II of the C&D Landfill, therefore; 15A NCAC 13B.0545 (*Assessment and Corrective Action Program for C&D Landfill Facilities and Units*) is applicable. Concentrations of PCE in monitoring well MW-28 have exceeded 2L Standards since April 2008 and have been generally increasing in concentration since that time. The attached **Figure 2** depicts the historic trend of PCE concentrations in groundwater monitoring well MW-28 since April 2008.

On April 18, 2013, S&ME on behalf of Lincoln County, submitted a letter to the North Carolina Department of Environment and Natural Resources Solid Waste Section (NCDENR-SWS) which acknowledged the PCE exceedances in groundwater monitoring well MW-28 and voluntarily entered Lincoln County into the applicable Assessment Program. The April 18, 2013 letter detailed initial actions of installing a down-gradient compliance boundary groundwater monitoring well and preparing an assessment work plan. The compliance boundary well location and installation and assessment work plan preparation was approved by the NCDENR-SWS in a letter dated May 29, 2013.

The approved down-gradient compliance boundary well, MW-36, was installed in June 2013 and a Groundwater Monitoring Well Installation Report was submitted by S&ME on behalf of Lincoln County to the NCDENR-SWS on August 14, 2013. On August 20, 2013, via email, the NCDENR-SWS accepted the Groundwater Monitoring Well Installation Report and requested proceeding with an assessment work plan.

Due to groundwater monitoring well MW-28’s close proximity to the unlined Area E, it is suspected that the PCE exceedances are coming from Area E and not the C&D Phase I landfill. Current supporting evidence includes analytical water quality data from groundwater monitoring well MW-17 which monitors side-gradient of Area E and is also located within the buffer area. PCE concentrations in MW-17 have fluctuated between detect and non-detect since April 2008. **Figure 3** depicts the historic trend of PCE concentrations in groundwater monitoring well MW-17 since April 2008. It should be noted that groundwater monitoring well MW-17 did not contain enough water volume to sample in October 2011 and October 2012. This issue will be discussed in more detail below in Section 2.1.

Additional characterization is needed within the buffer area. The following sections detail an alternate source demonstration (ASD) work plan to further evaluate the buffer area and determine the source of PCE exceedances in groundwater monitoring well MW-28.

## **2. ADDITIONAL WELL LOCATIONS**

There are three (3) existing groundwater observation wells located within the buffer area that were part of previous site studies, OW-1, OW-4A, and OW-16. S&ME anticipates using these three (3) existing groundwater observation wells for water level data and analytical data as part of the ASD. The locations of the three (3) existing groundwater observation wells are shown on the attached *Drawing 1 of 1*. Well details for the three (3) observation wells are included in *Table 1*.

To further evaluate groundwater flow direction and quality within the buffer area between Area E and the Phase I C&D landfill, S&ME proposes to install two (2) additional shallow groundwater monitoring wells (PMW-17R and PMW-37) at the Lincoln County Landfill. The locations of the proposed wells are indicated on the attached *Drawing 1 of 1*. The proposed groundwater monitoring wells will be installed in accordance with the 15A NCAC 2C standards.

### **2.1 Proposed Monitoring Well PMW-17R**

S&ME proposes to install groundwater monitoring well PMW-17R for dual purpose: 1) as a replacement well for the existing groundwater monitoring well MW-17; and 2) to aide in further characterization of the buffer area.

As mentioned above, existing groundwater monitoring well MW-17 monitors side-gradient of Area E and has historically contained water volumes insufficient for sampling. Existing groundwater monitoring well MW-17 has historically shown a pattern of water columns less than 2-feet and at times less than 1-foot for eleven (11) of the last twelve (12) semi-annual monitoring events. A chart depicting the groundwater elevation trend in existing groundwater monitoring well MW-17 has been included as *Figure 4*.

S&ME proposes to install replacement groundwater monitoring well PMW-17R approximately eighty (80) feet to the west of where the existing groundwater monitoring well MW-17 is located as shown on the attached *Drawing 1 of 1*. The proposed location for replacement groundwater monitoring well PMW-17R will continue to monitor side-gradient of Area E and will provide additional information from the buffer area.

### **2.2 Proposed Monitoring Well PMW-37**

S&ME proposes to install groundwater monitoring well PMW-37 within the buffer area as shown on the attached *Drawing 1 of 1*. The proposed location for groundwater monitoring well PMW-37 will provide additional soil and groundwater data within the buffer area.

## **3. DRILLING & MONITORING WELL INSTALLATION**

The two (2) proposed groundwater monitoring wells (PMW-17R and PMW-37) will be installed utilizing an ATV drill rig with 4.25-inch hollow-stem augers. Split-spoon samples will be collected every five (5) feet for soil classification and select laboratory testing (discussed below in Section 4). The groundwater wells will be constructed of 2-inch diameter Schedule 40 PVC casing with 15-feet of 0.010-inch machine slotted PVC

screen. The sand pack will consist of #2 silica sand extending from the base of the screen to approximately 2-feet above the screen. A 2-foot bentonite seal will be placed on top of the sand pack then completed to ground surface with a neat cement grout. A typical shallow groundwater monitoring well diagram is included in this report as **Figure 5**. Well screen elevations will be determined in the field by a North Carolina Registered Professional Geologist (PG) so that well screens bracket the groundwater surface.

To complete the groundwater monitoring wells, an above grade 4-inch by 4-inch steel protective cover with a lockable cap will be sealed in the center of a 2-foot by 2-foot concrete pad. The protective cover will be identified with a permanently affixed well I.D. tag in accordance with North Carolina well regulations.

After construction is complete, the groundwater monitoring wells will be surveyed to obtain ground surface elevations and top of PVC casing elevations. Well construction records will be submitted to the NCDENR- SWS following well completion and surveying.

#### **4. LABORATORY TESTING**

S&ME will perform laboratory grain-size distributions with hydrometer and specific gravity tests on selected split-spoon soil samples recovered from the saturated portion of the screened interval from each of the two (2) newly installed groundwater monitoring wells. S&ME will use the results of the laboratory grain size distribution with hydrometer and specific gravity tests to estimate porosity of the formation adjacent to the screened intervals of the groundwater monitoring wells.

#### **5. WELL DEVELOPMENT & SLUG TESTING**

Following installation, the two (2) new groundwater monitoring wells will be developed to remove clay, silt, and sand particles that may have been introduced into the formation or filter pack during installation. Development will be conducted as soon as practical after installation, but no sooner than twenty-four (24) hours after completion.

In order to evaluate the hydrogeological characteristics of the subsurface materials, S&ME will perform in-situ permeability tests (slug tests) in the two (2) newly installed groundwater monitoring wells. Slug tests will be performed in the field using the rising-head method, in which water is pumped from the well and recharge is recorded with time. Data collected from slug testing will be analyzed to calculate horizontal permeability. Slug tests will be conducted as soon as practical after the wells are developed, but no sooner than 24 hours after development to allow water levels to stabilize. Horizontal permeability calculated from slug tests will be used in conjunction with porosity calculated from grain-size analyses from saturated well screened intervals (discussed above in Section 4) to calculate groundwater flow velocities.

#### **6. GROUNDWATER SAMPLING**

The initial ASD sampling event will be scheduled to occur after development and slug testing of the two (2) newly installed wells. Subsequent ASD sampling will be on a

monthly basis for a period of four (4) months to establish any trends. The initial and subsequent ASD sampling events will include seven (7) groundwater wells: MW-17, PMW-17R, MW-28, OW-1, OW-4A, OW-16, and PMW-37.

Groundwater wells will be purged using a disposable Teflon® bailer and a minimum of three (3) well volumes will be removed at least twenty-four (24) hours prior to sample collection. Samples will be collected using a disposable Teflon® bailer and placed in laboratory provided sample bottles. Sample bottles will be packaged on ice and sent to a certified laboratory for analysis. Groundwater samples will be analyzed for total Appendix I metals and EPA Method 8260 volatile organic compounds. Groundwater analytical data will be compared to the 2L Standards and the NCDENR Solid Waste Groundwater Protection Standards (SW GWP Standards).

## **7. WATER QUALITY MONITORING PLAN (WQMP) UPDATE**

Proposed groundwater monitoring well PMW-17R will replace existing groundwater monitoring well MW-17 in the facility's WQMP however, existing groundwater monitoring well MW-17 will remain in-place for groundwater level measurements only. The existing compliance boundary groundwater monitoring well, MW-36, that was installed as part of the initial C&D Assessment will also be added to the facility's WQMP. Subsequent groundwater sampling will be on a semi-annual basis occurring in the months of April and October during sampling of the existing groundwater monitoring wells and surface water locations on-site.

## **8. REPORTING**

Following the four (4) monthly groundwater monitoring events for the buffer area, S&ME will submit an Alternate Source Demonstration (ASD) Report to the NCDENR-SWS which will include the following information:

- Groundwater monitoring well construction activities;
- Boring logs, well logs, and well construction records;
- Soil laboratory data;
- Well sampling activities and well sampling records;
- Groundwater analytical laboratory data;
- Calculations of hydraulic conductivity, porosity, and groundwater flow velocity;
- Groundwater surface map; and
- Recommendations for further (if any) assessment on-site (discussed in further detail below).

If the above described ASD assessment activities determine that Area E is *not* the source of the PCE exceedance at C&D groundwater monitoring well MW-28, Lincoln County will enter into assessment monitoring (sampling for Appendix II constituents) for the C&D Phase 1 and C&D Phase 2 groundwater monitoring wells, which include MW-26, MW-27, MW-28, MW-29, MW-30, MW-31, and MW-36).

## FIGURES







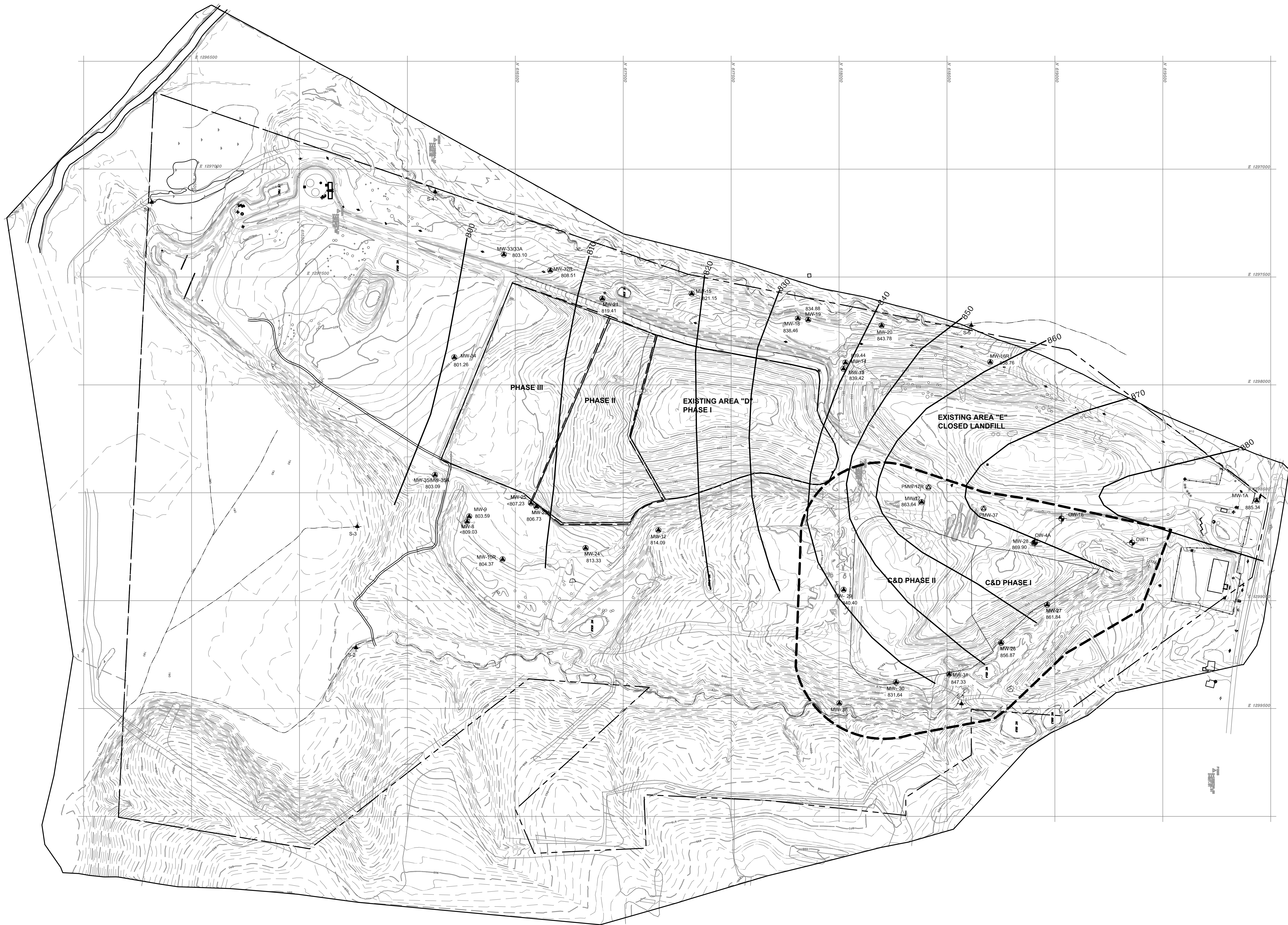
PROPOSED MONITORING WELL LOCATION MAP  
C & D ASSESSMENT

LINCOLN COUNTY LANDFILL  
CROUSE, NORTH CAROLINA

SAME ENGINEERING LICENSE NO. F-0176	
DRAWN BY: CLD	CHECKED BY:
DESIGNED BY: CWM	APPROVED BY:
PROJECT NUMBER 1356-13-009	

SCALE: 1" = 200'	DATE: 10-14-13
DRAWING: 1	OF: 1

DRAWING DATE: 10/14/13 LINCOLN COUNTY C&D ASSESSMENT MONITORING WELL LOCATION MAP.DWG



**LEGEND**

MW-1A EXISTING MONITORING WELL

S-1 SURFACE WATER SAMPLING LOCATION

885.34 GROUNDWATER SURFACE (10/8-9/12)

GROUNDWATER ELEVATION (R-msl)

PROPERTY BOUNDARY

PROPOSED MONITORING WELL

EXISTING OBSERVATION WELL

C & D COMPLIANCE BOUNDARY

**GRAPHIC SCALE**

200 0 100 200 400

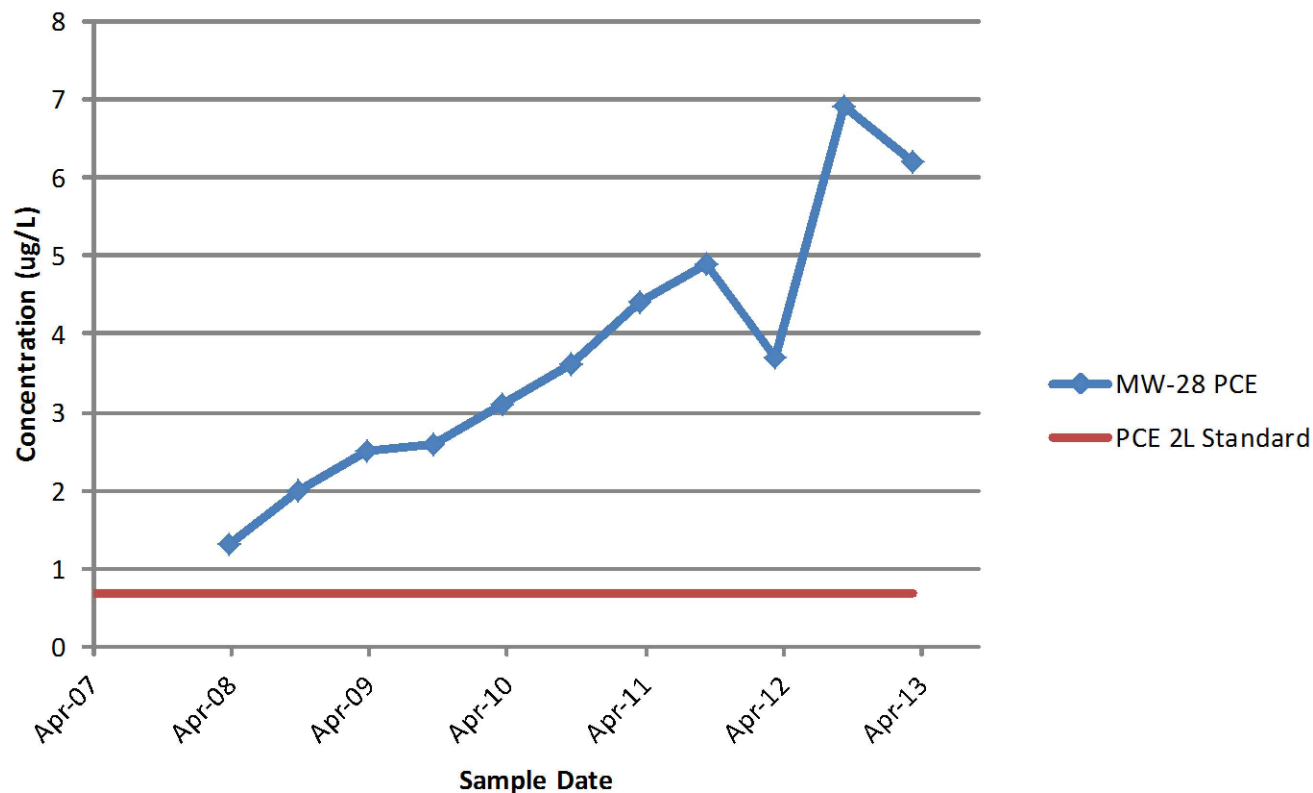
1" = 200'

( IN FEET )

1 inch = 200 ft.



## MW-28 PCE Trend



MW-28		
Sample Date	NCAC 2L Standard (µg/L)	PCE Concentration (µg/L)
Apr-07	0.7	ND
Oct-07	0.7	ND
Apr-08	0.7	1.3
Oct-08	0.7	2
Apr-09	0.7	2.5
Oct-09	0.7	2.6
Apr-10	0.7	3.1
Oct-10	0.7	3.6
Apr-11	0.7	4.4
Oct-11	0.7	4.9
Apr-12	0.7	3.7
Oct-12	0.7	6.9
Apr-13	0.7	6.2

SCALE: NTS

DATE: 10-21-13

PROJECT NO.  
1356-13-009

DRAWN BY:  
CLD

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ENGINEERING LICENSE NO: F-0176

### PCE TREND IN MW-28

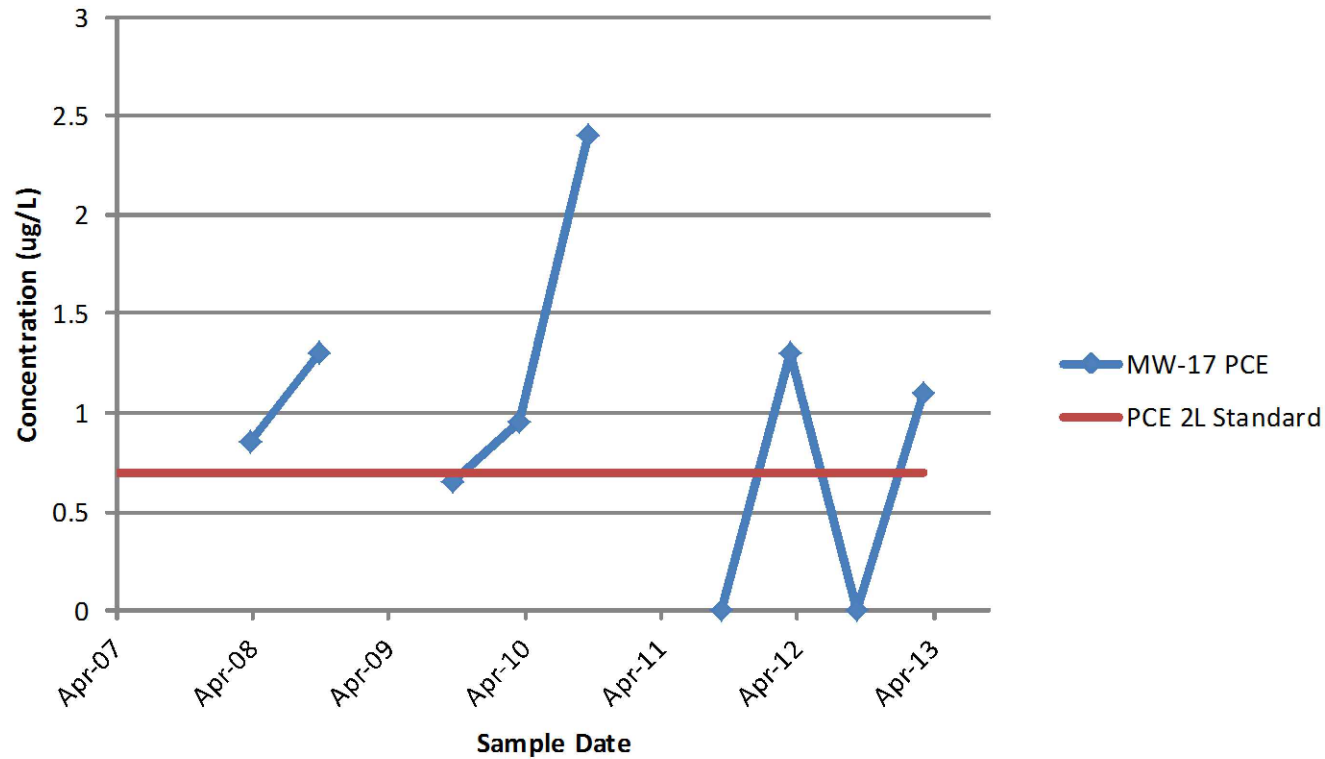
LINCOLN COUNTY C & D ASSESSMENT  
CROUSE, NORTH CAROLINA

FIGURE NO.

2

DRAWING PATH:

## MW-17 PCE Trend



MW-17		
Sample Date	NCAC 2L Standard	PCE Concentration (ug/L)
Apr-07	0.7	ND
Oct-07	0.7	ND
Apr-08	0.7	0.85
Oct-08	0.7	1.3
Apr-09	0.7	ND
Oct-09	0.7	0.65
Apr-10	0.7	0.96
Oct-10	0.7	2.4
Apr-11	0.7	ND
Oct-11	0.7	DRY
Apr-12	0.7	1.3
Oct-12	0.7	DRY
Apr-13	0.7	1.1

SCALE:	NTS	DATE:	10-21-13
PROJECT NO.	1356-13-009	DRAWN BY:	CLD
CHECKED BY:	CWM		



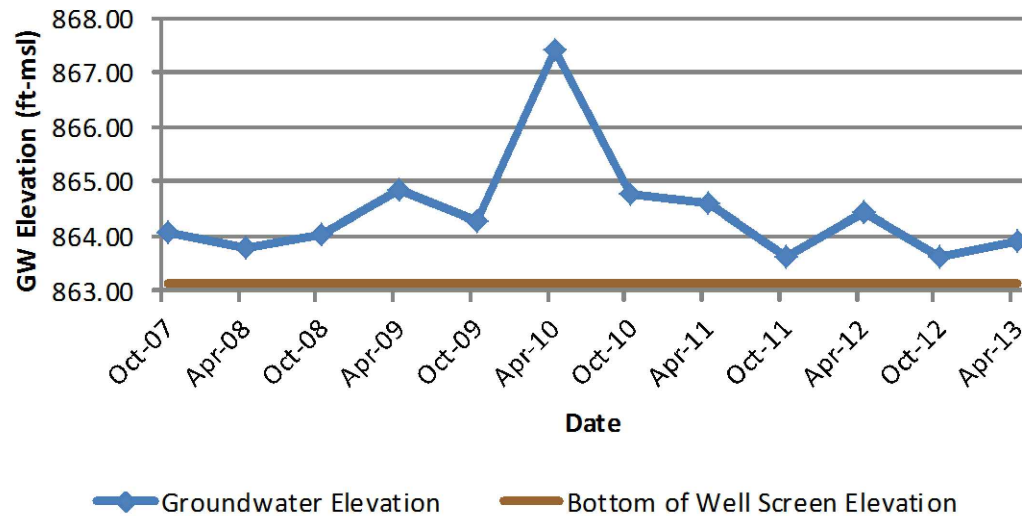
**PCE TREND IN MW-17**

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CROUSE, NORTH CAROLINA

FIGURE NO.  
**3**

DRAWING PATH:

## MW-17 Groundwater Elevation Trend



MW-17			
Date	GW Elev (ft-msl)	Bottom Well Elev (ft-msl)	Water Column (ft)
Oct-07	864.08	863.14	0.94
Apr-08	863.80	863.14	0.66
Oct-08	864.02	863.14	0.88
Apr-09	864.86	863.14	1.72
Oct-09	864.26	863.14	1.12
Apr-10	867.40	863.14	4.26
Oct-10	864.76	863.14	1.62
Apr-11	864.59	863.14	1.45
Oct-11	863.64	863.14	0.5
Apr-12	864.42	863.14	1.28
Oct-12	863.64	863.14	0.5
Apr-13	863.89	863.14	0.75

SCALE:	NTS	DATE:	10-21-13
PROJECT NO.	1356-13-009	DRAWN BY:	CLD
CHECKED BY:	CWM		



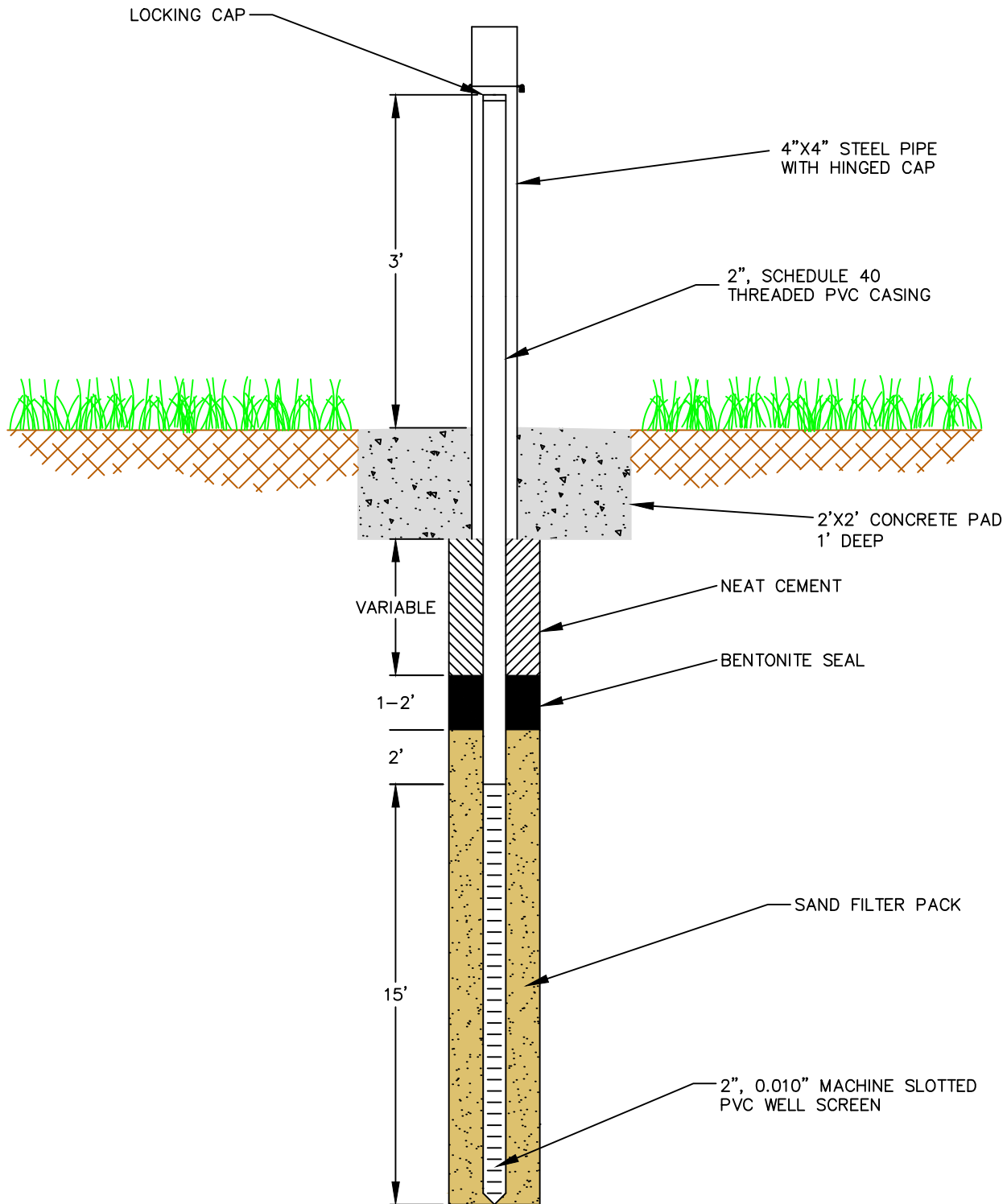
### MW-17 GROUNDWATER ELEVATION TREND

LINCOLN COUNTY C & D ASSESSMENT  
CROUSE, NORTH CAROLINA

FIGURE NO.

4

DRAWING PATH:



SCALE: NTS

DATE: 10-21-13

DRAWN BY: CLD

PROJECT NO: 1356-13-009

**S&ME**

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## TYPICAL TYPE II MONITOR WELL SCHEMATIC

LINCOLN COUNTY C & D ASSESSMENT  
CROUSE, NORTH CAROLINA

FIGURE NO.

**5**

## **TABLES**



**TABLE 1 - WELL DETAILS FOR EXISTING BUFFER AREA OBSERVATION WELLS**

Lincoln County Landfill - C&D Assessment Work Plan

S&ME Project No. 1356-13-009



Well ID	Water Level ft-TOC	Stick-up ft-als	Screened Interval ft- bls	Total Depth
OW-1	NM	~3	24 to 40	40
OW-4A	NM	~3	56 to 71	71
OW-16	41.23	~3	30 to 45	45

**Notes:**

Water level in OW-16 measured on October 8, 2013

Locks on OW-1 and OW-4A could not be opened. Water levels were not measured on October 8, 2013.

ft-TOC = feet from top of PVC casing

ft-als = feet above land surface

ft-bls = feet below land surface